PREPARED TESTIMONY OF LORI GARVER
EXECUTIVE DIRECTOR, NATIONAL SPACE SOCIETY

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THE INTERNATIONAL SPACE STATION

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MR. CHAIRMAN, MEMBERS OF THE SUBCOMMITTEE:

I would like to thank you, Chairman Burns, and the other members of the subcommittee, for giving me the opportunity to testify today. You are hearing a great deal from experts at NASA and in the aerospace industry regarding the future of the NASA budget and of our nation's space policy. I would like to add some suggestions from the National Space Society, a grassroots organization representing tens of thousands of ordinary Americans who want to see a flourishing space program that produces real results, not simply jobs and contracts.

THE VISION OF THE NATIONAL SPACE SOCIETY

The National Space Society is dedicated to the creation of a space-faring civilization and the establishment of communities beyond the Earth. Our mission is to promote change in social, technical, economic, and political conditions when people will live and work in space. We believe that the technologies and industries created on the space frontier will be of benefit to all humanity in the coming century. We further believe that opening the space frontier will create new opportunities for human life, liberty, and the pursuit of happiness.

Space activities today are still largely driven by governments. In the United States, the NASA budget was about $14.5 billion, reported military space activities were about $15.1 billion, and commercial space revenues were about $6.5 billion.[1] Yet total commercial space revenues have been growing at an average of 20 per cent per year for the last five years, some years being better than others. In contrast, U.S. government space spending will stay flat at best in constant dollars and will more likely decline. This is certainly true of NASA and may be true for the Department of Defense as well. What

this means is that commercial space revenues from communications, remote sensing, and satellite navigation (e.g., the Global Positioning System) will increase in importance. At current growth rates, commercial space will account for 40 per cent of U.S. space spending in the year 2000—five years away. If the growth rate drops in half, to 10 per cent per year, commercial space will still account for 28 per cent of U.S. space spending (Figure 1).

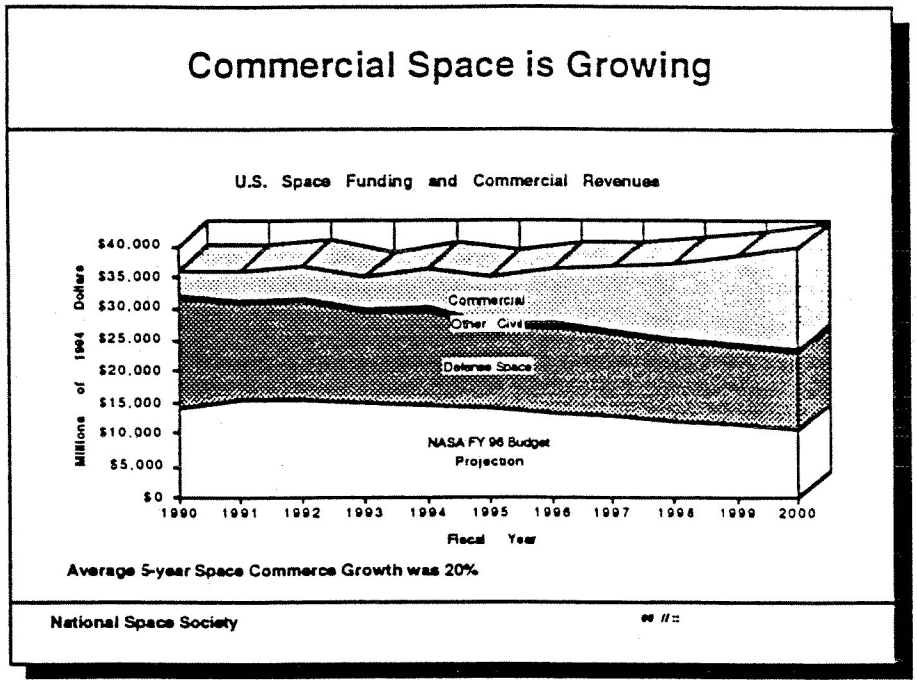

Figure 1

The National Space Society does not believe that the settlement of the Solar System can be accomplished with any single government program or even the cooperative efforts of many governments. Rather, space development and settlement will occur most effectively when the economic, technical, and social conditions allow individuals and non-governmental organizations (such as private firms and non-profits) to move into space on their own. The barriers to space development are many, but they can be put into two general categories: 1) immature, expensive technologies; and 2) government policies. The National Space Society supports efforts to remove both kinds of barriers.

There are many possible outcomes for the future of space development. In his book, "Humans in Space–21st Century Frontiers," Harry Shipman poses two cardinal questions.[2] First, can extraterrestrial resources be used to support humans in space? Second, will space

industrialization work? That is, can we "live off the land" and can we produce something of value to pay our way. If the answers to both questions are yes, than space settlement can occur. If the answers to both questions are no, then space is a realm for science and a few important, but earth-focused missions such as weather monitoring. If we can live off the land, but not produce anything of value, then space will be like Antarctica—a place for research and tourism, but not much else (Figure 2).

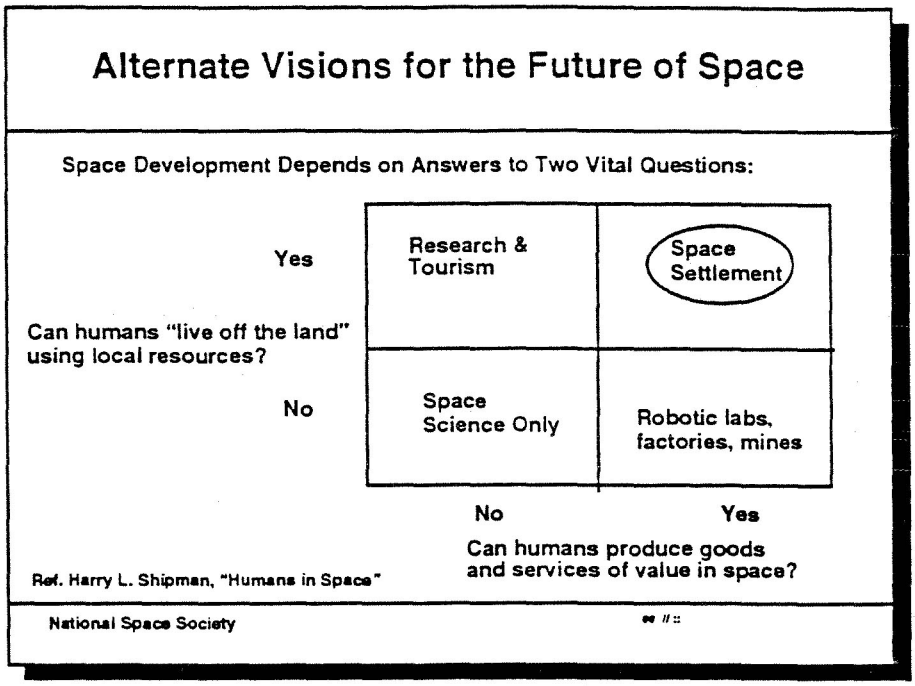

Figure 2

The members of the National Space Society believe the answers to both questions are yes. But belief is not the same as knowing. The answers to these questions produce such dramatically different outcomes for the future of space development that a modest level of public effort should be dedicated to answering them. I should point out that the Congress has already laid the basis for such efforts with passage of the 1988 Space Settlements Act.[3] This Act declares that "the extension of human life beyond Earth's atmosphere, leading ultimately to the establishment of space settlements." is a national goal requiring periodic reporting by NASA regarding how its programs are to advance this goal. With the exception of one report during the ill-fated Space Exploration Initiative effort, NASA has failed to provide the required reports to the Congress.

The lack of NASA reporting on progress toward space settlements is in part understandab1e. As long as such efforts were seen as requiring hundreds of billions of government-supplied dollars over decades, it was clear that the necessary political support would hardly be forthcoming after the end of the Cold War. NASA needs to recognize that it will not settle the space frontier any more than the Department of War and the Department of Agriculture settled the American West. **We suggest that a unique, post-Cold War role for NASA can be found in developing the technologies and gaining the data necessary for human expansion into the solar system. The ultimate purpose of NASA should be to empower individuals and private organizations to go into space for their own reasons**. Even in the present tough fiscal environment NASA can make valuable contributions to answering the questions I've poised. NASA is working with industry to lower the cost of access to space through the X-33 program, it is seeking to acquire information on local space resources through low-cost efforts such as the Lunar Prospector, and it can help create the tools necessary for space-based industries through the Space Station. As NASA Administrator Goldin has recognized, it is precisely the pressure of these budgets that create the incentives to think anew about a sustainable, long-term future for NASA

In a time of down-sizing and reduced resources, NASA needs to decide what its core competencies should be and how to maintain them. The recent NASA Zero Base Review is a strong and positive contribution to reducing institutional overhead and duplication. Since the debate over NASA's future is well under way, allow me to be blunt. Many proposed NASA missions could, in the extreme, be done by other agencies. Science, environmental monitoring, even space operations themselves, could be done by the National Science Foundation, the National Oceanic and Atmospheric Administration, and the Department of Defense: although the character of these operations would change to match their new homes. Space science and technology are the core of NASA but it is unclear what purposes this capability should serve. In a March 6 editorial, the New York Times said that the "space station makes minimal sense unless it is part of a broader plan of space exp1oration."[4] This is a vulnerability at the heart of NASA. A way must be found to give NASA a new post-Cold War purpose in light of fiscal realities or this unique agency will sooner or later close shop.

The New York Times criticized the Space Station and the Space Shuttle as making no sense because we have nowhere to go after them. In this, as is often the case, the editors of the Times were just about half right. The Space Shuttle and the Space Station would make little sense if we had no plans to go beyond them. But we do. The important thing is to ensure that our entire space program reflects those plans. And even in these times of strangled budgets, there are still things that we can do to promote progress toward the long term goal of opening the space frontier. The key fault in the Times' approach is its assumption that nothing significant will ever be done in space unless the government does it. But in fact, the Space Station should be viewed not as just another step in a long-term plan of purely government space activity, but as the opening wedge for large scale non-government activity in space. It will serve this purpose well if we pursue the proper policies over the next few years.

The National Space Society is not by definition a NASA supporter. Rather, we are supportive of NASA as their efforts coincide with our goals We stress that the opening of outer space as the next frontier, should serve as the overarching consideration against which all space policy and budgetary decisions are weighed. From our perspective, promoting space settlement is the only overarching goal for the Space Station; all other purposes, such as earth observation, astronomy, and the generation of general scientific knowledge, are secondary. Our views are based on this perspective. I will discuss a number of issues in this light.

THE ROLE OF THE SPACE STATION

Learning to Work in Space

The primary justification for the Space Station is that it will provide a place for learning more about living and working in space. This includes not only the “life sciences” research needed to determine whether humans can survive extended periods of microgravity in the context of, say, human missions to Mars. It also means much more basic things like tool and pressure suit design, psychology of long-term space operations, human productivity in space, life support technology, and so on. The important thing is that Space Station

capabilities, and plans for Space Station utilization, should be evaluated in the context of a long-term plan for developing the necessary skills to permit much larger-scale human presence in space.

The Space Station has to accommodate many diverse interests. On one hand, it is supposed to create operational capabilities such that the human presence in space may become "routine." Others insist it should be a major facility for commercial and industrial research. Still others say its primary purpose should be to advance state of the art science and technology. The Station will present its own set of unique problems that will make meeting these different objectives a challenge. Scientific and commercial users will want high amounts of communications bandwidth to monitor and control there experiments. The local area around the Station is likely to be "dirty" making vacuum-related research difficult. The constant shifting of crews, resources, and experiments will make it hard to maintain a "quiet" Station for microgravity researchers. There will be problems with equipment racks, stressed by launch into orbit, not fitting properly into their designated slots. Experiments will prove balky and take longer to hook-up than expected. Provisions will need to be made to deal with hazardous materials in and around the Station. And while critical areas of the Station itself may have protection against orbital debris, there will still be uncertain risks to crews working outside in pressure suits.

Space manufacturing, building large structures, and managing complex operations in remote and hostile environments are all skills that we will need to step further beyond Earth. There is a lot about living and working in space that we don't know, such as the most effective mix of humans and machines. As the Space Station develops the engineering skills for routine operations in space and on the ground, attention must be paid to areas such as a automation, robotics, and artificial intelligence systems. Only with technologies such as these will the human exploration of our ultimate frontier move forward.

International Cooperation

The Space Station is an international effort linking many nations. While the roles of the U.S.'s traditional partners have been altered with the entrance of Russia into the cooperative project, Canada, Japan, and the European Space Agency are still providing

billions of dollars in components to increase the Station's effectiveness. Furthermore, Russian contributions to Station design, auxiliary vehicles, and launch capabilities should enhance Station reliability and decrease the direct cost to the United States of development and operating expenses. While the U.S. will retain its role as the primary operator of the Station, Russian control facilities, launching inclinations, and experience will make the overall management of the Station more versatile and comprehensive.

The marriage of American and Russian space programs is a promising one. Our biggest problem is high cost; Russia's greatest strength is low cost. Our worst disadvantage is inexperience with permanently manned orbital facilities; Russia has been building and operating such facilities since the late seventies. We need experience with how people behave and adapt in the space environment. With Russia, we have begun the acquisition of this knowledge through collaboration aboard their presently orbiting facility, Mir. Partnerships that include the American and Russian programs can obtain results that neither could obtain alone, and at significant savings to both countries. A U.S. failure to successfully carry out its obligations to the international Space Station over the coming decades will likely damage future prospects for high technology cooperation as well as broader foreign policy interests.

If the United States and humanity are to ever expand into the solar system, it will most likely be in partnership with other spacefaring nations. The experience of working together on the Space Station will create problems in everything from incompatible technical standards and logistic support to cultural misunderstandings and legal disputes. The inclusion of Russia in the international Space Station has certainly provided examples of these challenges. But in the process of overcoming these problems together, we will be creating the strong foundations for a truly spacefaring civilization.

Meeting the Needs of Space Station Users, Customers, and the American People

As a grassroots group, we cannot speak with authority about the many difficult technical decisions involving in bringing the Station into reality. "What we can say is that the use of the Station is of paramount importance. The inevitable tensions between space

system operators and users goes back to the earliest days of spaceflight. Even though space system operators would often like to left alone and not have to deal with pesky users, it is the users that provide the rational for spaceflight projects. The Station cannot become an end in itself or it will not survive. Station resources such as volume, power, and the other utilities, crew time, and payload capacity up and down must be available in significant quantity beyond those resources needed to build and operate the Station itself. Policies for allocation of resources must allow for significant use by commercial R&D projects coupled with a realistic pricing policy to ensure the most productive use of the Station.

The Space Station design should be allowed to grow and change to accommodate different needs and wants as we move down the learning curve. Perhaps in the future users will move off the first Space Station to smaller robotic, or crew-tended stations of their own. A spacefaring civilization is unlikely to need only one Space Station, but will want several stations that separate research programs with conflicting requirements. This means that plans for the Space Station should allow for potential commercial opportunities for station operation and servicing. The Space Station should serve as the center of a growing civilian and commercial presence, not simply as the endpoint of a government program.

The Space Station partners, and especially the United States, should encourage efforts to supply privately developed systems for the diverse needs of the Space Station itself and those who will use this new international facility. This approach not only provides opportunities for the private sector, but creates options for Station users and reduces governmental risk in developing new space capabilities. In keeping with this approach, the partners should consider selling the Space Station to the private sector at the end of its design life.

The Station should be user friendly, and should accommodate people other than scientist/astronaut types. Space belongs to everyone, not just a few civil-service thoroughbreds, and recognizing this will help promote public involvement in the space program—and help build a knowledge base for space settlement, since space must ultimately be settled by ordinary people, not just the highly trained specialists who constitute most space travelers today.

This last point is in many ways the most important. U.S. government space projects belong to all Americans. One reason why such efforts have suffered in public esteem lately is that it has seemed an exclusive preserve of astronauts, bureaucrats, and contractors, leaving the American people feeling disconnected and distant. The money being spent on space programs belongs to the American people, not to the government and corporate officials who spend it.

In overseeing the money that goes into the NASA budget, you should ensure that what comes out of it represents all Americans, by supporting a Station that will develop capabilities that will eventually allow all Americans the opportunity to personally travel into space and develop new communities for themselves and their children if they so choose. A program that has that aim, and that pursues it credibly, will find political support easy. The editors of the Times were right that a space program that constitutes business as usual will surely fail. Where they were wrong was in their inability to imagine a space program that does not constitute business as usual. We know that this Congress already understands this point, and urge you to put our shared vision into practice.

RECOMMENDATIONS

The problems of the Space Station program to date have not been primarily technical, but managerial, and have stemmed from a sometimes unclear sense of what the Station should be for. The explicit adoption of our vision in the Station design process would have solved many of these problems, and provided a clear touchstone for evaluating different technical proposals. It still can and we have a few observations and recommendations to make:

- Either fund the Space Station fully or kill it. Do not cut it again or subject it to another redesign. There will be difficult decisions for NASA by pressing ahead with Station, but we agree with the NASA Administrator that it is time to get on with the program and make it work. We are sometime asked what we would do if the Station were canceled. If that were to happen I can promise that we would not go away, but

will come back to press for a permanent human return to the Moon with as many international partners as will still talk to us. We strongly urge the adoption of a multi-year authorization for the Space Station as a means of providing needed stability to the Station program and the plans of our spacefaring partners.

- Demand measurable performance and results from NASA and industry. Do not convene another commission, but ensure that there is a government mechanism for continuing, consistent, competent, non-advocacy reviews of Space Station progress. In particular, require outside (i.e., non-NASA) reviews of the resources, policies, and plans to support Space Station utilization.

- Press forward with flying hardware to separate the real engineers from the vu- graph artists. Be willing to support evolutionary improvements as we gain operational experience living and working in space.

- Develop long-term plans for the human expansion into space to provide a context for the role of the Space Station. New technology developments should support decisions for a permanent return to the Moon and human self-sufficiency in space.

We should work to ensure that the new millennium does not ring in with a space program like that of two decades ago — a space station burning up upon re-entry and no human access to space. An environment must not be created in which new and innovative programs are stretched out due to unstable budgets. We hope to work with this Congress to ensure that the new millennium begins with a permanently occupied international Space Station, testing of a new fleet of reusable space launch vehicles, and innovative, frequent missions to the Moon, Mars, and the asteroids.

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[1] Library of Congress, *Military Space Programs: Issues for the 104th Congress,* Marcia S. Smith, Congressional Research Service, 95-95 SPR, January 11, 1995; U.S. Department of Commerce/International Trade Administration, *U.S. Industrial Outlook, Chapter 28 - Space Commerce,* U.S. Government Printing Office, Washington, D.C., January 1994.
[2] Harry L. Shipman, *Humans in Space - 21st Century Frontiers*, Plenum Press, New York, 1989.
[3] Public Law 100-685, sec. 217; 102 Stat 4094; codified at 42 U.S.C. 2451 (1988)
[4] *New York Times*, Editorial March 6, 1995, pg. A14